

Site: Apples					Overall Confidence Rating: High			
Background: A total of 641,000 acres are planted in apples in the United states. Organophosphate pesticides (OP) represent 68% of all pesticide usage on this crop with an average of 2.82 applications per year. Analysis of OP usage was conducted for the following five major apple regions: New England (CT, MA, ME, RI, NH, NJ, NY, VT) , North Central (MI and OH), Appalachian-Southern (DE, GA, MD, NC, PA, SC, TN, VA, WV), Western (AZ and CA), and Pacific North. (OR and WA). Insecticide use patterns and key pests vary both between and within regions. In the absence of effective controls, key pests can destroy 50-90% of the crop. Due to low damage threshold levels in apples, biological control is limited to indirect pests (non-fruit feeding) with little contribution against direct pests.								
Organophosphate Pesticides	% Treated		# Applications		Rate (lb AI/A)		PHI (days)	
	Max ²³	Avg ²³	Max ²¹	Avg ²⁻¹¹	Max ²¹	Avg ²⁻¹¹	Min ²¹	Avg
azinphos-methyl	64.7	61.4	4	2.1	3.1	0.8	7	
chlorpyrifos	53	44	NS	1.6	4	1.4	30	
diazinon	6	3	NS	1.6	5	1.2	21	
dimethoate	14.9	7.4	NS	1.3	2.0	0.8	28	
malathion	15	10	NS	1.1	2.3	0.8	21	
methyl parathion	25	18	NS	1.0	2	2.0	21	
phosmet	34	22	NS	2.9	4	1.1	7	

Confidence Rating: H= high confidence = data from several confirming sources; confirmed by personal experience

M = medium confidence = data from only a few sources; may be some conflicting or unconfirmed info.

L = low confidence = data from only one unconfirmed source

Organophosphate Target Pests for Apple in New England Region (Primary pests controlled by the OP's) ^{6, 9, 17, 18}	
Major	Bug (Tarnished Plant), Aphids (Rosy Apple, Apple, and Spirea), Apple Maggot, Plum Curculio
Moderate	Leafroller (Obliquebanded and Redbanded))
Minor	Fruitworm (Green and Sparganothis), Sawfly (European Apple), Leafhopper (White Apple and Potato), Scale (San Jose), Mite (European Red), Leafminer (Spotted Tentiform)

Major = 20+% of all OP usage on pest; Moderate = 5-20% of all OP usage on pest; Minor =<5% of all OP usage on pest

Organophosphate Target Pests for Apple in North Central Region (Primary pests controlled by the OP's) ^{7, 10, 16}	
Major	Codling Moth, Apple Maggot
Moderate	Aphid (Green Apple and Rosy Apple), Fruitworm (Green), Leafroller (Fruit Tree, Red Banded, Oblique Banded, and Variegated), Scale (San Jose), Plum Curculio,
Minor	Mites (European Red, Rust, and Two Spotted Spider), Fruit/Bud Moth (Oriental Fruit, Tufted Apple Bud, and Eye-Spotted Bud), Leafminer (), Bug (Tarnished Plant and Stink), Leafhopper (White Apple and Potato), Borer (Dogwood)

Major = 20+% of all OP usage on pest; Moderate = 5-20% of all OP usage on pest; Minor =<5% of all OP usage on pest

Organophosphate Target Pests for Apple in Appalachian-Southern Region (Primary pests controlled by the OP's) ^{3, 4, 14, 15}	
Major	Aphid (Rosy Apple, Apple, Spirea and Apple Grain), Codling Moth
Moderate	Leafroller (Red Banded and Oblique Banded), Scale (San Jose), Mites (European Red, Twospotted Spider, and Apple Rust), Bug (Tarnished Plant and Mullein Plant), Leafhopper (White Apple, Rose, and Potato)
Minor	Fruit/Bud Moth (Tufted Apple Bud and Oriental Fruit), Leafminer (Spotted Tentiform), Plum Curculio, Apple Maggot, Fruitworm (Green)

Major = 20+% of all OP usage on pest; Moderate = 5-20% of all OP usage on pest; Minor =<5% of all OP usage on pest

Organophosphate Target Pests for Apple in Western Region (Primary pests controlled by the OP's) ^{8, 19, 20}	
Major	Aphid (Rosy Apple, Green Apple, and Green Peach), Codling Moth
Moderate	Scale (San Jose, Italian Pear, and Grape Mealybug)
Minor	Mites (European Red, Apple Rust, Pacific Spider, and McDaniel Spider), Borer (Pacific Flatheaded)

Major = 20+% of all OP usage on pest; Moderate = 5-20% of all OP usage on pest; Minor =<5% of all OP usage on pest

Organophosphate Target Pests for Apple in Pacific North Region (Primary pests controlled by the OP's) ^{2, 11, 12, 13}	
Major	Leafrollers (Pandemis, Oblique Banded, Fruittree, and European), Codling Moth
Moderate	Scale (San Jose and Oystershell), Fruitworm (Green, Speckled Green, and Pyamidal), Apple Maggot, Aphid (Green Apple, Rosy Apple, and Apple Grain), Mites (European Red, Apple Rust, Twospotted Spider, and McDaniel Spider)
Minor	

Major = 20+% of all OP usage on pest; Moderate = 5-20% of all OP usage on pest; Minor =<5% of all OP usage on pest

Sources:

1. Proprietary EPA market share information.
2. U.S. Apple QUA+ - Washington. 1997.
3. U.S. Apple QUA+ - Virginia, West Virginia. 1997.
4. U.S. Apple QUA+ - Georgia, North Carolina, South Carolina and Tennessee. 1997.
5. U.S. Apple QUA+ - Pennsylvania. 1997.
6. U.S. Apple QUA+ - New England. 1997.
7. U.S. Apple QUA+ - Michigan. 1997.
8. U.S. Apple QUA+ - California. 1997.
9. QUA+ - New England Fruit Consultants.
10. QUA+ Michigan Apple Commission. 1997
11. QUA+ - Northwest Horticultural Council. 1997.
12. Orchard Pest Management; A Resource Book for the Pacific Northwest.1993. Good Fruit Grower, Yakima, WA.
13. Pacific Northwest 1998 Insect Control Handbook. 1998. Oregon State University.
14. 1997 Spray Bulletin for Commercial Tree Fruit Growers. Virginia, West Virginia and Maryland Cooperative Extension.
15. Pennsylvania Tree Fruit Production Guide. 1996-1997. College of Agricultural Science, Penn State University.
16. 1997 Fruit Spraying Calendar for Commercial Fruit Growers. 1997. Bulletin E-154. Michigan State University Extension.
17. Pest Management Recommendations for Commercial Tree Fruit Production. 1997. Cornell University.
18. 1996-1997 New England Apple Pest Management Guide. Cooperative Extension (Universities. of Connecticut, New Hampshire, Maine, Rhode Island, Massachusetts and Vermont)
19. Apple Pest Management Guidelines. 1996. UCPMG Publication 12. IPM Education and Publications, Univ.- CA, Davis.
20. Integrated Pest Management for Apples and Pears. 1991. Publication 3340. University of California.
21. Label Use Information System (LUIS) Version 5.0, EPA.
22. The All-Crop, Quick Reference Insect Control Guide (1997), Meister Publishing Company
23. EPA Crop Profile QUA.

Site: Apples
Region: West

Pest ¹⁻⁴	Organophosphate ¹⁻⁶	Efficacy ²⁻⁴	Mkt ¹		Class	Alt. Pesticide List ¹⁻⁵	Efficacy ²⁻⁴	Mkt ¹	Constraints of Alternatives ^{2,3,4}
Timing: Pre-Bloom									
Aphid (Rosy apple, Green apple, and Green peach) (Major)	chlorpyrifos	---	High		C	carbaryl	---	Lo	Carbamate and pyrethroid use will disrupt biological control of mites due to their greater efficacy against mite predators.
	diazinon	---	High		C	methomyl	---	Lo	
	phosmet	---	Lo		O	petroleum oil	---	High	
Scale (San Jose, Italian pear, and Grape mealybug) (Moderate)	diazinon	---	High		O	insecticidal soap	---	Lo	
	phomet	---	Lo		O	petroleum oil	---	Lo	
Codling Moth (Moderate)	azinphos-methyl ⁷	---	Lo		C	carbaryl	---	Lo	Carbamates and Pyrethroids show cross or multiple resistance to OP's. Both pesticide classes are harmful to mite predators with resulting mite flare-ups. Pheromone mating disruption to control Codling Moth requires supplemental chemical intervention. Mating disruption is not effective in orchards with high populations of Codling Moth. Tree banding to trap larvae only recommended for small orchards
	chlorpyrifos	---	High		O	petroleum oil	---	Lo	
	diazinon	---	Lo		O	Tree banding	---	---	
	phosmet	---	Lo						

Pest Importance: Major = 20+% of all OP usage on pest; Moderate = 5-20% of all OP usage on pest; Minor = <5% of all OP usage on pest

Efficacy Rating: Excellent = ☺ Good = ○ Fair = ● --- = Not rated for efficacy in state recs.

Market Share: High = 20+% OP usage on pest; Med = 5-20% of all usage on pest; Lo = <5% of all usage on pest; --- = not available for 1994-96.

Insecticides: C = Carbamates; P = Pyrethroids; CH = Chlorinated Hydrocarbons; IGR = Insect Growth Regulators; B = Biological; O = Other pesticide

Site: Apples
Region: West

ADDITIONAL INFORMATION:

Apple production in the Western Region (California and Arizona) accounts for 8.8% of total acreage and 9.7 % of production for the US. OP usage during the Post-Bloom period in the Western region is 69.8% of all pesticide usage.

SOURCES:

1. Proprietary EPA market share information.
2. U.S. Apple QUA+ - California. 1997.
3. Apple Pest Management Guidelines. 1996. UCPMG Publication 12. IPM Education and Publications, University of California, Davis.
4. Integrated Pest Management for Apples and Pears. 1991. Publication 3340. University of California.
5. The All-Crop, Quick Reference Insect Control Guide (1997), Meister Publishing Company.
6. Label Use Information System (LUIS) Version 5.0, EPA.
7. New 1998 restrictions for azinphos-methyl use in California may change use patterns of this pesticide.

Date: 01/28/99

Pest Importance: Major = 20+% of all OP usage on pest; Moderate = 5-20% of all OP usage on pest; Minor = <5% of all OP usage on pest

Efficacy Rating: Excellent = ☺ Good = ○ Fair = ● --- = Not rated for efficacy in state recs.

Market Share: High = 20+% OP usage on pest; Med = 5-20% of all usage on pest; Lo = <5% of all usage on pest; --- = not available for 1994-96.

Insecticides: C = Carbamates; P = Pyrethroids; CH = Chlorinated Hydrocarbons; IGR = Insect Growth Regulators; B = Biological; O = Other pesticide

Site: Apples
Region: West

Pest ¹⁻⁴	Organophosphate ¹⁻⁶	Efficacy ²⁻⁴	Mkt ¹	Class	Alt. Pesticide List ¹⁻⁵	Efficacy ²⁻⁴	Mkt ¹	Constraints of Alternatives ^{2,3,4}
Timing: Post-Bloom								
Codling Moth (Major)	azinphos-methyl ⁷	---	High	C	carbaryl	---	Lo	Carbamates and Pyrethroids show cross or mutiple resistance to OP's. Both pesticide classes are harmful to mite predators with resulting mite flare-ups.
	chlorpyrifos	---	Mod	P	esfenvalerate	---	Lo	
	diazinon	---	Lo	CH	endosulfan	---	Lo	
	methyl parathion	---	Lo	O	Bacillus thuringiensis	---	Lo	Pheromone mating disruption to control Codling Moth requires supplemental chemical intervention. Mating disruption is not effective in orchards with high Codling Moth populations.
	phosmet	---	High	O	fenbutatin oxide	---	Lo	
				O	petroleum oil	---	Lo	
				O	pheromone	---	Lo	
				O	tree banding	---	---	Tree banding to trap larvae only recommended for small orchards.
Aphid (Rosy apple, Green apple, and Green peach) (Moderate)	azinphos-methyl ⁷	---	Lo	C	carbaryl	---	Lo	Carbamate and Pyrethroid use will disrupt biological control of mites due to their greater efficacy against mite predators.
	chlorpyrifos	---	High	C	methomyl	---	Lo	
	diazinon	---	High	P	pyrethrins	---	Lo	
	dimethoate	---	Lo	CH	endosulfan	---	Lo	
	malathion	---	Lo	B	azadirachtin	---	Lo	
	phosmet	---	Lo	O	fenbutatin oxide	---	Lo	
				O	insecticidal soap	---	Lo	
				O	petroleum oil	---	Lo	

Pest Importance: Major = 20+% of all OP usage on pest; Moderate = 5-20% of all OP usage on pest; Minor = <5% of all OP usage on pest

Efficacy Rating: Excellent = ☺ Good = ○ Fair = ● --- = Not rated for efficacy in state recs.

Market Share: High = 20+% OP usage on pest; Med = 5-20% of all usage on pest; Lo = <5% of all usage on pest; --- = not available for 1994-96.

Insecticides: C = Carbamates; P = Pyrethroids; CH = Chlorinated Hydrocarbons; IGR = Insect Growth Regulators; B = Biological; O = Other pesticide

Site: Apples
Region: West

Pest ¹⁻⁴	Organophosphate ¹⁻⁶	Efficacy ²⁻⁴	Mkt ¹	Class	Alt. Pesticide List ¹⁻⁵	Efficacy ²⁻⁴	Mkt ¹	Constraints of Alternatives ^{2,3,4}
Timing: Post-Bloom								
Borer (Pacific flathead) (Minor)	azinphos-methyl ⁷	---	High	O	fenbutatin oxide	---	Lo	Carbamates and Pyrethroids are harmful to natural predators of mites with resulting increase in mite outbreaks.
	diazinon	---	Mod	O	petroleum oil	---	Lo	
	parathion	---	High					
	phosmet	---	Lo					
Mites (European red, Apple rust, Pacific spider, and McDaniel spider) (Minor)	azinphos-methyl ⁷	---	Mod	C	carbaryl	---	Lo	Use of Pyrethroids and Carbamates will cause resurgence of mites as a pest with associated increase in miticide application and potential for resistance development.
	chlorpyrifos	---	Lo	CH	dicofol	---	High	
	diazinon	---	Mod	O	abamectin	---	Lo	
				O	clofentezine	---	Lo	
				O	fenbutatin oxide	---	Mod	
				O	formetanate hydrochloride	---	Lo	
				O	petroleum oil	---	Mod	
				O	propargite	---	High	
				O	sulfur	---	Lo	
Scale (San Jose, Italian pear, and Grape mealybug) (Minor)	chlorpyrifos	---	High	O	fenbutatin oxide	---	Lo	
	diazinon	---	High	O	petroleum oil	---	Lo	
	methyl parathion	---	Lo					

Pest Importance: Major = 20+% of all OP usage on pest; Moderate = 5-20% of all OP usage on pest; Minor = <5% of all OP usage on pest

Efficacy Rating: Excellent = ☺ Good = ○ Fair = ● --- = Not rated for efficacy in state recs.

Market Share: High = 20+% OP usage on pest; Med = 5-20% of all usage on pest; Lo = <5% of all usage on pest; --- = not available for 1994-96.

Insecticides: C = Carbamates; P = Pyrethroids; CH = Chlorinated Hydrocarbons; IGR = Insect Growth Regulators; B = Biological; O = Other pesticide

Site: Apples
Region: West

ADDITIONAL INFORMATION:

Apple production in the Western Region (California and Arizona) accounts for 8.8% of total acreage and 9.7 % of production for the US. OP usage during the Post-Bloom period in the Western region is 78.9% of all pesticide usage.

SOURCES:

1. Proprietary EPA market share information. 1994-96.
2. U.S. Apple QUA+ - California. 1997.
3. Apple Pest Management Guidelines. 1996. UCPMG Publication 12. IPM Education and Publications, University of California, Davis.
4. Integrated Pest Management for Apples and Pears. 1991. Publication 3340. University of California.
5. The All-Crop, Quick Reference Insect Control Guide (1997), Meister Publishing Company.
6. Label Use Information System (LUIS) Version 5.0, EPA.
7. New 1998 restrictions for azinphos-methyl use in California may change use patterns of this pesticide.

Date: 01/28/99

Pest Importance: Major = 20+% of all OP usage on pest; Moderate = 5-20% of all OP usage on pest; Minor = <5% of all OP usage on pest

Efficacy Rating: Excellent = ☺ Good = ○ Fair = ● --- = Not rated for efficacy in state recs.

Market Share: High = 20+% OP usage on pest; Med = 5-20% of all usage on pest; Lo = <5% of all usage on pest; --- = not available for 1994-96.

Insecticides: C = Carbamates; P = Pyrethroids; CH = Chlorinated Hydrocarbons; IGR = Insect Growth Regulators; B = Biological; O = Other pesticide